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The impact of patellar tendinopathy on sports and work performance in active athletes

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ABSTRACT

Greater insight into sports and work performance of athletes with patellar tendinopathy (PT) will help establish the severity of this common overuse injury. Primary aim of this study is to investigate the impact of PT on sports and work performance. Seventy seven active athletes with PT (50 males; age 28.1 ± 8.2 years; Victorian Institute of Sports Assessment Patella 56.4 ± 12.3) participated in this survey. Sports performance, work ability and work productivity were assessed using the Oslo Sports Trauma Research Center overuse injury questionnaire, the single-item Work Ability Index and the Quantity and Quality questionnaire, respectively. Reduced sports performance was reported by 55% of the participants; 16% reported reduced work ability and 36% decreased work productivity, with 23% and 58%, respectively, for physically demanding work. This study shows that the impact of PT on sports and work performance is substantial and stresses the importance of developing preventive measures.

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Jumper's knee; injury severity score; prevention; athletic injury

Introduction

Patellar tendinopathy (PT) is a painful overuse injury of the patellar tendon. Short-term overuse of the tendon causes a reactive tendon that can return to normal when load is adjusted. When high load persists the injury can become more chronic (Cook, Rio, Purdam, & Docking, 2016). The pain that characterizes this chronic injury is activity-related and is often located just below the patella, proximally in the tendon. High prevalence rates are found especially in jumping athletes (Lian, Engebretsen, & Bahr, 2005; Zwerver, Bredeweg, & Van Den Akker-Scheek, 2011). Despite the numerous treatment options currently available (Gaida & Cook, 2011), treatment outcomes remain variable and none of them guarantee complete recovery. As a result, the symptoms tend to be long-lasting (Kettunen, Kvist, Alanen, & Kujala, 2002). The development of preventive measures is therefore extremely important. As described by Van Mechelen, Hlobil, and Kemper (1992), the first step in the “sequence of prevention” should be to

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unravel the extent of the problem, not only in terms of frequency (i.e. incidence or prevalence) but also in terms of severity (Bahr, 2009; Van Mechelen et al., 1992).

Important factors for determining the severity of sports injuries include “sporting time lost” and “working time lost” (Van Mechelen et al., 1992). As was discussed in several studies (Bahr, 2009; Clarsen, Myklebust, & Bahr, 2013), sporting time lost is probably not an accurate measure to gain insight into the severity of overuse injuries like PT, as symptoms or functional limitations arise gradually, and most athletes continue participating in sports despite their symptoms, especially in the early phase of the injury. When the severity of pain worsens, athletes are forced to adapt their training and/or competition programme/workload and often seek medical assistance. Only after a period of failed attempts at injury management will athletes quit sports participation (Clarsen et al., 2013). Hence only the more severe and longer-standing problems resulting in inability to participate in sports would be captured measuring sporting time lost. Assessing the limitations in performance or the functional level is a more suitable way to determine injury severity (Bahr, 2009).

Similar to what was described for overuse injuries in sports (Bahr, 2009; Clarsen et al., 2013), measuring working time lost (absence) would not be sufficient to gain insight into the impact of PT on work (employment). The effect of PT on work is scarcely investigated; one study found that athletes with PT do not change or cease employment because of their knee problem (Kettunen et al., 2002), but another study found that PT can influence work performance negatively (Van Der Worp, Zwerver, Kuijer, Frings-Dresen, & Van Den Akker-Scheek, 2011). The latter study found among 18–35-year-old basketball and volleyball players especially people with heavy, physically demanding work indicated being impaired in their work performance (50% in sports-related work and 27% in non-sports-related work). Also the productivity at work seemed lower (Van Der Worp et al., 2011).

Gaining more insight into sports performance (the limitations during sports) and work performance levels (the limitations during employment) of athletes with PT will help establish the severity and related impact of this common injury. The primary aim of this exploratory study is therefore to investigate the impact of PT on sports performance and work performance in athletes with PT. The secondary aim is to explore which personal characteristics, sports-related factors and work-related factors are associated with decreased work and sports performance.

Materials and methods

Study population and design

This survey was conducted between February 2013 and June 2015 and was administered among participants of two studies on the effectiveness of a patellar strap for PT (ethical approval METc 2012/378 and METc 2014/528) (De Vries et al., 2015). Written informed consent was obtained from all individual participants included in the study. Athletes between the 18 and 50 years old (to reduce the risk for the presence of degenerative joint diseases) who were clinically diagnosed with PT by an experienced sports clinician were invited to take the survey. Only active athletes who participated in sports at least once a week, who had current symptoms in one or both knees, palpation

tenderness of the patellar tendon, symptoms over three months and a Victorian Institute of Sport Assessment Patella (VISA-P) score below 80 (Visentini et al., 1998; Zwerver, Kramer, & Van Den Akker-Scheek, 2009) were included. Patients without employment or those who were professional athletes were excluded. Also patients with chronic joint diseases or signs or symptoms of other knee pathologies were excluded.

Questionnaires

Using the questionnaires, information was obtained about athletes' baseline characteristics, sports performance and work performance.

Baseline characteristics

Using a baseline questionnaire, information was obtained about participants' personal characteristics, type of sport(s), the duration of sports performance, training volume, level of participation and the duration of symptoms (in months).

Sports performance

The Dutch translation (Pluim, Loeffen, Clarsen, Bahr, & Verhagen, 2015) of the Oslo Sports Trauma Research Centre (OSTRC) overuse injury questionnaire of Clarsen et al. (2013) was used to evaluate the impact of PT on the ability to participate in sports. The OSTRC overuse injury questionnaire has good internal consistency (Clarsen et al., 2015, 2013) and is considered valid to record overuse injuries (Clarsen, Ronsen, Myklebust, Florenes, & Bahr, 2014). The questionnaire consists of four items asking questions about sports performance related to the knee problems in the previous month. Participant's difficulties participating in sports (item 1), any reduction in training volume (item 2) or performance (item 3) and the severity of knee pain during sports (item 4) were assessed. The sports performance ranges from 0 (no difficulties) to 100 (maximum level of difficulties during sports) (Clarsen et al., 2013). Clarsen et al. considered an injury to be substantial when moderate or severe reductions in training volume (item 2) or sports performance (item 3) were documented or when there was complete inability to participate (Clarsen et al., 2014). In this study participants were classified as having low sports performance when Clarsen's criteria for a substantial injury were met. In addition, athletes were asked how many days they were unable to (fully) participate in sports in the preceding week.

Work performance

Participants were asked if they had paid employment, for how many hours, and if their employment was either physically demanding and/or mentally demanding. In addition, the single-item Work Ability Index (WAI) (Ahlstrom, Grimby-Ekman, Hagberg, & Dellve, 2010; Tuomi, Ilmarinen, Jahkola, Katajarinne, & Tulkki, 1998; Tuomi et al., 1998) was included, comparing current work ability with lifetime best work ability. The single-item WAI can be used as a simple indicator of self-assessed work ability (Ahlstrom et al., 2010) and has a very strong association with the seven-item WAI questionnaire, which in turn relates well with clinically assessed factors (Eskelinen, Kohvakka, Merisalo, Hurri, & Wägar, 1991). The score on the single-item WAI ranges from 0 (not able to work) to 10 (work ability at its best). A score <8 is

considered as low working ability, a score ≥ 8 is considered as high working ability (Gould, Ilmarinen, Järvisalo, & Koskinen, 2008). The Quantity and Quality (QQ) questionnaire (Brouwer, Koopmanschap, & Rutten, 1999) was used to gain insight into the quantity of work the participants experienced. Participants were asked to rate their current quantity of work compared to what it would be like if they had no symptoms of PT. The score ranges from 1 (no productivity) to 10 (full productivity). Participants with a score < 10 are considered to have decreased productivity of work. The QQ questionnaire relates well with the objective work output (Meerding, IJzelenberg, Koopmanschap, Severens, & Burdorf, 2005).

Analysis

Participants were included when all questionnaires were filled out in their entirety. The results were presented as frequencies, means and standard deviations, except for PT duration and hours of work per week (median and interquartile range) because of skewness of the data. A univariate logistic regression analysis was used to investigate which personal (gender, age, length, weight, BMI), injury-related (knee PT, VISA-P score, duration of symptoms), sports-related (playing level, hours of sports participation per week [primary and total], OSTRC score) or work-related factors (type of work, hours per week, WAI, QQ quantity) were possible predictors for low work ability, decreased productivity and low sports performance. No multiple logistic regression analysis could be performed because of the small sample size. Since the PT duration and the hours of work per week were skewed, these variables were categorized before including them in the regression. Data were analysed using SPSS Statistics version 22. The level of significance was set at $p < 0.05$.

Results

Of the 94 participants who filled out the questionnaires, 77 were included in the analysis due to one or more questions unanswered. Seventeen participants were excluded because one or more questionnaires were missing. Participant characteristics are shown in Table 1.

Sports performance

Table 2 shows the distribution of scores on the OSTRC overuse injury questionnaire. The median number of days that participants were unable to do sports the preceding week was 0 (IQR 1.3). Forty-two out of 77 participants (54.5%) were classified as having low sports performance.

Work performance

Table 3 shows the distribution of the score on the single-item WAI and the QQ quantity questionnaire. Twelve participants (16.0%) had a score below 8 on the single-item WAI (range 3–7), and 28 participants (36.4%) had decreased work productivity (QQ Quantity < 10) due to their knee problems.

Table 1. Descriptive statistics of the participants.

<i>N</i>	77
Personal characteristics	
Age (years)	28.1 (8.2)
Gender (male/female)	50 /27
BMI ^a (kg/m ²)	23.8 (2.9)
Injury-related factors	
Knee PT (left/right/both)	18 /22 /37
VISA-P (0–100) ^b	56.4 (12.3)
PT duration (months)	18.0 (28.0)
Sports-related factors	
Playing level (recreational/regional/national/international) ^c	32 /29 /15 /1
Sport (hours per week) ^c	4.5 (2.2)
Work-related factors	
Type of work (physical/mental/mixed)	26 /35 /16
Working hours per week	32.0 (27.5)

PT, patellar tendinopathy.

^aBody Mass Index, ^b Victorian Institute of Sport assessment patella ^cprimary sports.

Displayed values are frequencies and means (SD), except for PT duration and working hours per week (median and interquartile range).

Table 2. Frequency distribution on the Oslo Sports Trauma Centre (OSTRC) overuse injury questionnaire.

	<i>n</i> (%)
Total	77 (100)
Participation	
Full participation without knee problems	4 (5.2)
Full participation, but with knee problems	45 (58.2)
Reduced participation due to knee problems	22 (28.6)
Cannot participate due to knee problems	6 (7.8)
Volume of training	
No reduction	29 (37.7)
To a minor extent	23 (29.9)
To a moderate extent	9 (11.7)
To a major extent	13 (16.9)
Cannot participate at all	3 (3.9)
Performance	
No effect	7 (9.1)
To a minor extent	28 (36.4)
To a moderate extent	13 (16.9)
To a major extent	25 (32.5)
Cannot participate at all	4 (5.2)
Symptoms	
No pain	3 (3.9)
Mild pain	31 (40.3)
Moderate pain	28 (36.4)
Severe pain	15 (19.5)
Mean (SD) ^a	45.1 (23.2)

^a A score of 0 on the OSTRC overuse injury questionnaire indicates optimal sports performance, 100 indicates no sports performance.

Of the 26 participants who had physically demanding work, 23.1% had a WAI score below 8 and 57.7% had a decreased QQ quantity score. In the group of 35 participants who performed mentally demanding work these percentages were 8.6% for WAI and 20.0% for QQ quantity. Of the participants who did mixed work ($n = 16$), 18.8% scored below 8 on the WAI, and 37.5% had a decreased QQ quantity score.

Table 3. Frequency distribution on WAI and QQ Quantity.

Score	WAI	QQ Quantity
	<i>n</i> (%)	<i>n</i> (%)
0	0 (0)	-
1	0 (0)	0 (0)
2	0 (0)	0 (0)
3	0 (0)	0 (0)
4	1 (1.3)	0 (0)
5	1 (1.3)	1 (1.3)
6	1 (1.3)	3 (3.9)
7	9 (11.7)	6 (7.8)
8	16 (20.8)	4 (5.2)
9	22 (28.6)	14 (18.2)
10	27 (35.1)	49 (63.6)
Total	77	77
Mean (SD)	8.8 (1.3)	9.3 (1.2)

WAI, Work Ability Index; QQ, Quantity and Quality.

Factors associated with decreased work and sports performance

Table 4 presents participants' characteristics of the work ability (WAI), work productivity (QQ quantity) and sports performance (OSTRC overuse injury questionnaire) split into high and low for the WAI and OSTRC and into decreased and normal for QQ quantity.

Table 5 presents the results from the logistic regression analysis. In terms of personal characteristics no associations were found for decreased work or sports performance. In the injury-related factors, a lower VISA-P score (indicating more symptoms) increased the odds of having low work ability and low sports performance. In the sports-related factors, a higher score on the OSTRC overuse injury questionnaire (more problems during sports) was found to be significantly associated with low work ability. In the work-related factors, physically demanding work resulted in significantly higher odds of having decreased work productivity than for mentally demanding work.

Discussion

The primary aim of this study was to investigate the impact of PT on sports and work performance. Athletes with PT reported a substantial negative impact on sports performance (55%) work ability (16%) and productivity (36%). The secondary aim was to explore which factors were associated with decreased work and sports performance, and the most evident result was that having PT is related to decreased work productivity in athletes with heavy physical demanding work.

Sports performance

The OSTRC overuse injury questionnaire, used in this study to measure sports performance, shows that almost all athletes experience problems during sports performance while as expected the time loss as a result of PT is low. More than half of the participating athletes had a decreased sports performance – moderate or severe reductions in training volume or sports performance, or complete inability to participate in training or competition. The OSTRC overuse injury questionnaire is designed to monitor the severity of overuse injuries in a selected group of athletes and not in a specific

Table 4. Characteristics of participants with decreased and good work and sports performance.

	Low work ability (n = 12)	High work ability (n = 65)	Decreased productivity (n = 28)	Normal productivity (n = 49)	Low sports performance (n = 42)	High sports performance (n = 35)
Personal characteristics						
Gender						
Male	6 (50)	44 (68)	17 (61)	33 (67)	28 (67)	22 (63)
Female	6 (50)	21 (32)	11 (39)	16 (33)	14 (33)	13 (37)
Age	27.5 (10.2)	28.2 (7.9)	27.6 (8.5)	28.3 (8.2)	28.3 (8.9)	27.8 (7.5)
Length, in m	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)
Weight, in kg	78.8 (13.8)	80.7 (11.4)	79.3 (15.5)	81.0 (9.1)	80.7 (13.8)	80.1 (9.0)
BMI ^a	23.8 (2.7)	23.8 (3.0)	23.8 (3.3)	23.8 (2.7)	24.0 (3.4)	23.4 (2.2)
Injury-related factors						
Knee PT						
Left	2 (17)	16 (25)	3 (11)	15 (31)	10 (24)	8 (23)
Right	3 (25)	19 (29)	9 (32)	13 (27)	12 (29)	10 (29)
Both	7 (58)	30 (46)	16 (57)	21 (43)	20 (48)	17 (49)
VISA-P (0–100) ^b	47.8 (13.8)	58.0 (11.4)	53.7 (12.1)	58.0 (12.2)	53.2 (12.3)	60.3 (11.3)
PT duration (months)	27.5 (34.3)	17.0 (27.5)	18.0 (28.5)	16.0 (27.5)	15.5 (24.4)	24.0 (36.0)
Sports-related factors						
Playing level^b						
Recreational	4 (33)	28 (43)	11 (39)	21 (43)	21 (50)	11 (31)
Regional	4 (33)	25 (39)	11 (39)	18 (37)	15 (36)	14 (40)
National	4 (33)	11 (17)	6 (21)	9 (18)	6 (14)	9 (25)
International	0 (0)	1 (2)	0 (0)	1 (2)	0 (0)	1 (3)
Sport (h per week) ^c	5.4 (2.8)	4.3 (2.1)	4.5 (2.5)	4.5 (2.1)	4.1 (2.3)	4.9 (2.2)
Total h sport week	7.6 (3.6)	6.0 (2.9)	6.8 (3.5)	6.0 (2.8)	5.7 (2.8)	6.9 (3.2)
OSTRC score (100–0)	59.7 (22.0)	42.4 (22.5)	50.7 (22.3)	41.9 (23.2)	-	-
Work-related factors						
Type of work						
Mental	3 (25)	32 (49)	7 (25)	28 (57)	18 (43)	17 (49)
Mixed	3 (25)	13 (20)	6 (21)	10 (20)	7 (17)	9 (26)
Physical	6 (50)	20 (31)	15 (54)	11 (22)	17 (41)	9 (26)
H per week	34.5 (34.3)	32.0 (27.0)	32.0 (25.8)	32.0 (28.0)	32.0 (26.0)	32.0 (28.0)
WAI (0–10)	-	-	7.9 (1.2)	9.2 (1.1)	8.6 (1.4)	8.9 (1.0)
QQ quantity (1–10)	7.8 (1.0)	8.5 (0.9)	-	-	9.2 (1.2)	9.3 (1.3)

PT, patellar tendinopathy; OSTRC, Oslo Sports Trauma Research Center; WAI, Work Ability Index; QQ, Quantity and Quality.

^aBody Mass Index, ^bVictorian Institute of Sport Assessment patella ^cprimary sports.

Displayed values are frequencies (percentage) and means (SD), except for PT duration and hours per week (median and interquartile range).

injured population, as was done in the current study (Clarsen et al., 2013). To our knowledge, no severity scores are known for other overuse injuries. As a result, the impact of PT cannot (yet) be compared to the consequences of other overuse injuries in sports.

Work ability

Since a reduced work ability has proven to predict long-term sickness absence, decreased work performance, productivity loss, more healthcare use and early exit

Table 5. Results from the univariate logistic regression analysis for reduced WAI, QQ quantity and having low sports performance.

	Work ability Ref = low		Productivity Ref = decreased		Sports performance Ref = low	
	OR	95% CI	OR	95% CI	OR	95% CI
Personal characteristics						
Gender (ref = male)						
Female	2.1	0.6–7.3	0.7	0.3–2.0	0.8	0.3–2.2
Age	1.0	0.9–1.1	1.0	0.9–1.0	1.0	1.0–1.1
Length in m	0.0	0.0–20.1	0.0	0.0–5.7	0.1	0.0–17.1
Weight in kg	1.0	0.9–1.0	1.0	0.9–1.0	1.0	1.0–1.0
BMI ^a	1.0	0.8–1.2	1.0	0.9–1.2	1.1	0.9–1.3
Injury-related factors						
Knee PT (ref = unilateral)						
Bilateral	1.6	0.5–5.7	1.8	0.7–4.5	1.0	0.4–2.4
VISA-P (0–100) ^b (10 pnt increase)	0.5*	0.3–0.9	0.7	0.5–1.1	0.6*	0.4–0.9
PT duration (ref = < 6 months, <i>n</i> = 10)						
6–12 months, <i>n</i> = 21	1.3	0.1–14.9	0.4	0.1–2.0	0.6	0.1–3.6
12–24 months, <i>n</i> = 25	0.7	0.1–8.5	0.5	0.1–2.7	0.4	0.1–2.6
>24 months, <i>n</i> = 32	2.0	0.2–19.6	0.7	0.1–3.4	0.2	0.0–1.4
Sports-related factors						
Playing level (ref = recreational)						
Regional	1.1	0.3–5.0	1.2	0.4–3.6	0.6	0.2–1.6
National	2.5	0.5–12.0	1.3	0.4–4.8	0.3	0.1–1.3
International	-	-	-	-	-	-
Sport (hours per week) ^c	1.2	0.9–1.6	1.0	0.8–1.2	0.8	0.7–1.0
Total hours sport week	1.2	1.0–1.4	1.1	0.9–1.3	0.9	0.7–1.0
OSTRC overuse injury questionnaire (100–0) (10 points increase)	1.4*	1.1–1.9	1.2	1.0–1.5	-	-
Work-related factors						
Type of work (ref = mental)						
Mixed	2.5	0.4–13.8	2.4	0.6–8.9	0.7	0.2–2.4
Physical	3.2	0.7–14.3	5.5 **	1.8–17.0	1.8	0.6–5.1
Hours per week (ref = < 16 h, <i>n</i> = 31)						
16–32 h, <i>n</i> = 17	0.4	0.0–3.7	1.1	0.3–4.3	2.3	0.6–9.0
32–40 h, <i>n</i> = 29	0.6	0.1–2.8	1.0	0.3–2.9	1.2	0.4–3.4
>40 h, <i>n</i> = 11	2.0	0.4–10.4	1.2	0.3–5.3	1.0	0.2–4.2
WAI (0–10)	-	-	0.4 **	0.2–0.6	0.8	0.6–1.2
QQ quantity (1–10)	0.4**	0.2–0.6	-	-	1.0	0.7–1.4

PT, patellar tendinopathy; OSTRC, Oslo Sports Trauma Research Center; WAI, Work Ability Index; QQ, Quantity and Quality.

^aBody Mass Index, ^bVictorian Institute of Sport Assessment patella ^cprimary sports.Significant predictor of decreased work ability/productivity at work or for decreased sports performance **p* < 0.05, ***p* < 0.01.

from work, it is important to assess the concept of work ability (Ahlstrom et al., 2010; Alavinia, Molenaar, & Burdorf, 2009; Reeuwijk, Robroek, Hakkaart, & Burdorf, 2014; Sell, 2009). A large Finnish health survey showed that in an average working population of 30–64 year olds, 8% of the women and 7% of the men reported having limited work ability (measured using WAI); for physically demanding work these percentages were 13% and 10%, respectively (Gould et al., 2008). In this average working population the decreased work ability is a lot smaller than what was found in the current study for active athletes with PT (16% among the total population and 23% among those with physical demanding work). This may indicate that PT has a negative influence on work ability.

Work productivity

Assessing the impact on productivity at work is particularly interesting because the majority of the costs related to an injury are caused by lost productivity while being at work (Hermans et al., 2012). Whilst the study supports previous findings of Van Der Worp et al. (2011), this present study observed greater decrease in work productivity. In the present study work productivity decreased in 36% of the participants, whereas in the study of Van Der Worp et al. (2011) only 8% had decreased work productivity. This could be due to some differences in populations, but the most plausible explanation for this difference is that the current study uses more sensitive measurement instruments to assess work productivity. Our participants had to choose between 10 answer options (0 [no work productivity] to 10 [optimal work productivity]) compared to the previous study (Van Der Worp et al., 2011) which had a binary response option (“yes” and “no”). It is likely that those athletes would not have answered “yes” when experiencing small reductions in productivity, but the current study did measure these small reductions.

Surprisingly, hardly any data about work performance in other tendinopathies are available. In patients with upper extremity disorders seeking medical advice (29% epicondylitis medialis and lateralis, 28% rotator cuff tendinitis or impingement syndrome), 56% had reduced productivity at work (Martimo et al., 2009). It seems logical for upper extremity pain to result in a larger decrease in productivity compared to a knee injury, as the upper extremities are involved in all types of work (mental, physical and mixed). This study demonstrates that PT has a comparable impact on work productivity as was found in mild-to-moderate knee osteoarthritis (36% versus 40% decreased work productivity), despite the younger age of our study population (28 versus 53 years of age) (Hermans et al., 2012). A study by Meerding et al. (2005) showed that 5–12% of industrial and construction workers had reduced work productivity as a result of health problems (Meerding et al., 2005). Given the high physical demands of industrial and construction work, a comparison with our participants who had physically demanding work is reasonable. Almost 58% of the athletes with PT who had physically demanding work had decreased work productivity. It can therefore be concluded that PT certainly has an effect on work productivity, especially when physically demanding work is involved, and as a result the financial effect will be considerable.

Associated factors with decreased work and sports performance

The second aim of this study was to investigate which factors were associated with decreased work and sports performance. Having more symptoms (lower VISA-P score) was the sole determining factor found for athletes with PT having low sports performance – this is a common-sense association which may also have been enhanced by the fact that sports performance is part of the VISA-P questionnaire (40 out of 100 points) (Visentini et al., 1998). As already demonstrated previously (Van Der Worp et al., 2011), type of work is clearly related to the impact of PT on work performance. This is not surprising, given that a negative association is found between physical work and productivity at work (Hermans et al., 2012), and that PT is an overuse injury with mainly activity-related symptoms. In agreement with previous studies, having more symptoms was found to be related to decreased work ability

(Hermans et al., 2012; Langley et al., 2010). The finding that a higher OSTRC score (indicating more limitations during sports) increased the odds for having decreased work ability demonstrates a relationship between work and sports performance. Having low sports performance was most of the time not accompanied by decreased work ability (only nine patients with low sports performance also had a low WAI score [(21% data not shown)] whereas in most cases (9 out of 12, 75%) having decreased work ability is also associated with decreased sports performance. Those nine patients who scored low on both aspects – and not solely on sports performance – seem to have more symptoms (VISA-P 47 ± 15 compared to 55 ± 11), a longer duration of symptoms (median 24 ± 105 months compared to 15 ± 17 months), more hours of sports a week (7 ± 4 h compared to 5 ± 2 h) and more physically demanding work (56% physical, 33% mental, 11% mixed compared to 36% physical, 46% mental and 18% mixed), although this is not statistically significant.

Limitations

There are some limitations in this study that should be kept in mind. The first limitation has to do with the relatively small sample size and generalizability of the population. The number of participants with low work ability was small ($n = 12$), therefore no multiple regression analysis could be performed because of a lack of power. It might also be that the athletes included in this study are not entirely representative. Our PT population consisted of athletes still actively playing; while those who were no longer participating in sports were excluded. This has most probably led to an underestimation, indicating that the actual impact of PT on sports and work participation is even larger than reported in the present study. Our study population furthermore included many students who had side jobs, resulting in a relatively low average age and a rather large group that worked for less than 16 h.

A second limitation is related to the questionnaires used. The QQ quantity questionnaire and the OSTRC overuse injury questionnaire specifically asked if one experienced limitations in work or sports because of symptoms of PT; therefore, these results represent the consequences of PT on work productivity and sports performance experienced by the athlete. The single-item WAI, which compares one's current work ability with the lifetime best, is associated with several factors (e.g. high work demands, lack of autonomy, lack of leisure-time physical activity, obesity, older age) (Van Den Berg, Elders, De Zwart, & Burdorf, 2009), so the obtained work ability results may be influenced by factors other than PT. Finally, since this study has a cross-sectional design, the causality of the factors associated with decreased sports and work performance cannot be established.

Recommendations

A specific recommendation for future studies is to also include inactive athletes with PT in addition to active athletes who are still participating in sports. By analysing the total PT population, better insight into the actual impact of this injury on work (and sports) performance can be obtained. It might furthermore be interesting to exclude students with side jobs or to analyse this group separately. The questionnaires we used are

monitoring instruments, important in identifying whether there is a problem and its extent. It would be certainly interesting to investigate in future research the exact underlying cause of decreased sports and work performance in addition. As the current study shows that the impact on both sports and work participation is considerable, this stresses even more the need for additional research into the development of effective preventive measures for PT.

Conclusions

The present study shows that the severity and the related impact of the sports injury of PT on sports as well as on work performance is substantial, especially considering that solely actively playing athletes with PT were included. The impact of PT on work is particularly large among those who do physically demanding work. It is important to do more research into the impact of PT on both the sports and the work performance domains. The results of this study already provide more knowledge about the severity of PT, which is an important yardstick towards the development of preventive measures for this injury.

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